Trip to Lowell to see Evgenya Shkolnik, June 30-July 4

I drove from Tucson to Flagstaff, AZ to meet with Evgenya Shkolnik and her new postdoc, Joe Llama. I submitted a Hubble Fellowship application to work with Evgenya, and although I was not awarded that fellowship, Evgenya and I still wanted to work with each other. She has a large dataset, compiled over years of observations, that can serve and connect both of our research interests. The data set includes high-resolution spectroscopy from five different instruments of many different exoplanet host stars. I will measure the host star abundances, and Evgenya and her postdoc will measure activity indicators from the spectra and correlate them with the exoplanet orbital properties to search for star-planet interactions.

When I visited, we first met to survey/catalog the data and determine what was ready for analysis (reduced) and what still needed initial reduction. Joe worked on cross-correlating the data from different instruments – for which objects did we have multiple data sets? – and writing a new code to read in all of the data and measure the activity indicators in a uniform way. I worked on reducing data from the HIRES instrument on Keck that was not ready for analysis, using a pipeline I already had working on my computer. Joe and Evgenya did not have the pipeline, so Evgenya and I also worked to get the pipeline running on her computer so she could reduce data from HIRES in the future.

To calibrate some of the data, from the MIKE instrument on the Magellan telescope, we needed spectra of the sun. I had a MIKE observing run in July, so took those spectra and have been working on reducing them for our analysis. Through other collaborators, I learned that several of the targets in our sample are interesting for reasons beyond our planned investigation. Several of the stars have transiting giant planets, for which another collaborator of mine is obtaining atmosphere measurements. This means that both my abundance measurements and Joe and Evgenya's activity measurements of the host star can be related to the exoplanet atmospheric composition. Another subset of the stars in our sample have directly-imaged giant planets, which also have atmospheric measurements from very high resolution infrared spectroscopy. Since our goal is to explore how host star abundances and activity influence exoplanet composition, these overlaps will increase the significance of our work. Joe and Evgenya and I are scheduled to "meet" virtually on Dec. 8th to update each other and set our next set of goals for the first half of 2015.

Trip to Gemini North with Steve Howell, July 17-25

The NAI Grant helped supplement an award I received from Gemini Observatory, called the "Bring One, Get One" grant. With the combined awards, I traveled to Gemini North Telescope at Mauna Kea Observatory in Hawaii to participate in an observing run with the Differential Speckle Survey Instrument. This instrument is specialized to detect close-in companions around stars, and has been used in the past to validate *Kepler* "objects of interest" that may be planets, but may also be background or blended stars. At Gemini, I helped the instrument team of Steve Howell, Elliot Horch, Mark Everett, and David Ciardi unpack and mount the instrument, meaning I got to see the internal mechanisms and mirrors in DSSI, and better understand how each piece contributed to creating the speckle

images. We suffered through a few nights of no observations due to a tropic storm, but got on sky after a few rainy nights. I ran the queue, helped keep a log of the observations, and got to talk to and get to know the whole team during our observing and meal-time conversations.

For this project, I have been collecting all of the published (or publicly available, through the Community Follow-up Observin Program archive) speckle and adaptive optics imaging observations of *Kepler* targets, with much help from David's postdoc Elise. We want to compare and correlate what information the different observations provide, in terms of companion separation, brightness, and position angle, to better characterize the multiplicity of *Kepler* targets and, in some cases, improve the measurements of the transiting exoplanets. I made plots of every target (~250) for which there are published/archived measurements from a speckle or AO imaging instrument, and Elise and I discussed some of the most interesting/curious cases. Our next step is to include more information in our database, like errors on the measurements, distances to the stars, and metallicities of the stars. Ultimately I want to relate stellar multiplicity and metallicity to the type of planets that form, and the DSSI observations I helped conduct will be an important component of this analysis. I will stay involved with the team, and hopefully go observing again next year.

Trip to University of CA, Santa Cruz to meet with Jonathan Fortney, Sept. 9-12

The original purpose of my visit to Jonathan was to conduct observations on the Keck Telescope at Mauna Kea from the remote observing facilities at UCSC. However, over the summer I met another observer (Andrew Howard of the University of Hawaii) who agreed to conduct our observations, as our assigned night (9/12) was the night before I was to leave for a conference in Portugal. Thus, my trip to UCSC instead was used to update Jonathan on the status of the observations for our project, and work on grant and telescope proposal applications related to our collaboration project. This was actually extremely helpful, as there had been a lot of communication (and mis-communication) regarding target lists and the data we needed to get or had in hand. Jonathan and I were able to sit down and lay out a plan for the project, which also involves another postdoc and a graduate student, and then write clear and persuasive grant and proposal applications to further our work. What in the past had taken a week or more, Jonathan and I were able to accomplish quickly and effectively in the few days of my visit.

I have since analyzed one of the ~25 targets in our sample (this analysis is time consuming, especially when starting from "raw" data as I was), and have already been awarded more time on MIKE at Magellan to observe the last of our southern targets. This is a long-term project; Jonathan and I will be working together for at least a few years, so I will visit him again, especially once my fellowship takes me to Pasadena in 1.5 years.

In addition, Jonathan also took me to a local exoplanet conference at NASA Ames, where we heard from exoplanet and host star researchers from around southern CA. Since I am for the time being based in Washington, DC, I would not have attended this meeting otherwise, nor do I have the opportunity to interact with these astronomers frequently. I actually

initiated a new collaboration at this conference with Heather Knutson of Caltech, and I am going to meet with her in mid-December when I visit Pasadena for an observing planning meeting at Carnegie Observatories.

Below I include some pictures from the second two trips; unfortunately I didn't get any pictures at Lowell!

Me with DSSI mounted on the Gemini Telescope (DSSI is inside that white cage)

The DSSI observing team (L-R) me, Steve Howell (in red), Elliot Horch, David Ciardi (on the computer), Mark Everett

Sea lions on the wharf in Santa Cruz

Look at the wharf from across the beach in Santa Cruz